

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

PART I *What is the material and what do I need to know in an emergency?*

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: **ETHYLENE, GASEOUS - C₂H₄**
ETHYLENE, LIQUEFIED -C₂H₄ (Cryogenic)
 Document Number : 001022

PRODUCT USE: For General Analytical/Synthetic Chemical Uses

SUPPLIER/MANUFACTURER'S NAME: AIRGAS INC.
ADDRESS: 259 N. Radnor-Chester Road
 Suite 100
 Radnor, PA 19087-5283

BUSINESS PHONE: 1-610-687-5253
EMERGENCY PHONE: 1-800-949-7937
 International: 423-479-0293 (Call Collect)

DATE OF PREPARATION: May 12, 1996
REVISION DATE: February 6, 2004

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH-TLV		OSHA-PEL		NIOSH IDLH ppm	OTHER ppm
			TWA ppm	STEL ppm	TWA ppm	STEL ppm		
Ethylene	74-85-1	> 99%	NIC = 100	Ethylene is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.	Ethylene is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.	NE	Carcinogen: IARC-3; MAK-3B; TLV-A4	
Maximum Impurities		< 1%	None of the trace impurities in this mixture contribute significantly to the hazards associated with the product. All hazard information pertinent to this gas has been provided in this Material Safety Data Sheet, per the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200) and State equivalent standards.					

NE = Not Established.

See Section 16 for Definitions of Terms Used.

NOTE (1): ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-1998 format. This gas has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Ethylene is a colorless, flammable gas with a slightly sweet odor or a colorless, cryogenic liquid with a slightly sweet odor. This gas acts as a simple asphyxiant and presents a significant health hazard by displacing the oxygen in the atmosphere. The gas may spread long distances. Distant ignition and flashback are possible. The cryogenic liquid will rapidly boil to the gas. The liquefied gas can cause frostbite to any contaminated tissue. Both the liquid and gas pose serious fire hazards when accidentally released. Flame or high temperature impinging on a localized area of the cylinder of this gas can cause the cylinder to rupture without activating the cylinder's relief devices. Ethylene can undergo a violent chemical reaction at elevated temperatures. Provide adequate fire protection during emergency response situations.

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: The most significant route of overexposure for Ethylene is by inhalation. The following paragraphs describe symptoms of exposure by route of exposure.

3. HAZARD IDENTIFICATION (Continued)

INHALATION: Exposure to extremely high concentrations of Ethylene (20%) can cause anesthetic effects. High concentrations of this gas can cause an oxygen-deficient environment. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. The skin of a victim may have a blue color. Under some circumstances of overexposure, death may occur. The effects associated with various levels of oxygen are as follows:

CONCENTRATION	SYMPTOMS OF EXPOSURE
12-16% Oxygen:	Breathing and pulse rate increased, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea and vomiting, collapse or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.



OTHER POTENTIAL HEALTH EFFECTS: Contact with cryogenic liquid or rapidly expanding gases (which are released under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain after contact with product can quickly subside.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Overexposure to Ethylene may cause the following health effects:

ACUTE: The most significant hazard associated with this gas is inhalation of oxygen-deficient atmospheres. Symptoms of oxygen deficiency include respiratory difficulty, headache, dizziness and nausea. At high concentrations, unconsciousness or death may occur. Contact with cryogenic liquid or rapidly expanding gases may cause frostbite.

CHRONIC: There are currently no known adverse health effects associated with chronic exposure to Ethylene. Chronic exposure to oxygen-deficient atmospheres (below 18% oxygen in air) may affect the heart and nervous system.

TARGET ORGANS: ACUTE: Respiratory system. CHRONIC: Heart, central nervous system.

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM			
HEALTH HAZARD		(BLUE)	2
FLAMMABILITY HAZARD		(RED)	4
PHYSICAL HAZARD		(YELLOW)	2
PROTECTIVE EQUIPMENT			
EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8
For Routine Industrial Use and Handling Applications			

See Section 16 for Definition of Ratings

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

Remove victim(s) to a safe location. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Victim(s) must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to physician or other health professional with victim(s).

In case of frostbite, place the frostbitten part in warm water. DO NOT USE HOT WATER. If warm water is not available, or is impractical to use, wrap the affected parts gently in blankets. Alternatively, if the fingers or hands are frostbitten, place the affected area of the body in the armpit. Encourage victim to gently exercise the affected part while being warmed. Seek immediate medical attention.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: None known.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure. Cryogenic dermal injuries should be treated by water bath re-warming at 40 to 42°C until vasodilatory flush has returned. Elevation of the limb and standard frostbite management with late surgical debridement should be utilized. Ocular exposure requires irrigation and slit-lamp evaluation for injury.

5. FIRE-FIGHTING MEASURES

FLASH POINT: -136.6°C (-213°F)

AUTOIGNITION TEMPERATURE: 490°C (914°F)

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): 2.7%

Upper (UEL): 36%

FIRE EXTINGUISHING MATERIALS: Extinguish fires of this gas by shutting-off the source of the gas. Use water spray to cool fire-exposed containers, structures, and equipment. DO NOT USE HALOGENATED FIRE EXTINGUISHING AGENTS; explosive reaction can occur.

5. FIRE-FIGHTING MEASURES (Continued)

UNUSUAL FIRE AND EXPLOSION HAZARDS: When involved in a fire, this gas ignites to produce toxic gases including carbon monoxide and carbon dioxide. An extreme explosion hazard exists in areas in which the gas has been released, but the material has not yet ignited. Ethylene can undergo a violent chemical reaction at elevated temperatures.

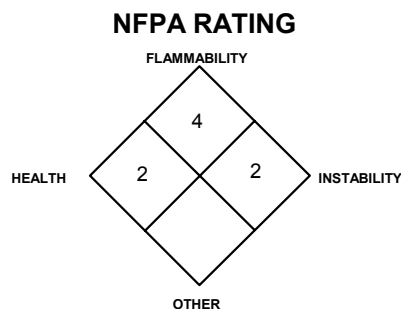
DANGER! Fires impinging (direct flame) on the outside surface of unprotected pressure storage vessels of Ethylene can be very dangerous. Direct flame exposure on the cylinder wall can cause an explosion either by BLEVE (Boiling Liquid Expanding Vapor Explosion), or by exothermic decomposition. This is a catastrophic failure of the vessel releasing the contents into a massive fireball and explosion. The resulting fire and cylinder rupture can result in severe equipment damage and personnel injury or death over a large area around the vessel. For massive fires in large areas, use unmanned hose holder or monitor nozzles; if this is not possible, withdraw from area and allow fire to burn.

RESPONSE TO FIRE INVOLVING CRYOGEN: Cryogenic liquids can be particularly dangerous during fires because of their potential to rapidly freeze water. Careless use of water may cause heavy icing. Furthermore, relatively warm water greatly increases the evaporation rate of Ethylene. If large concentrations of Ethylene gas are present, the water vapor in the surrounding air will condense, creating a dense fog that may make it difficult to find fire exits or equipment. Liquid Ethylene, when exposed to the atmosphere, will produce a cloud of ice/fog in the air upon its release. A flammable mixture could exist within the vapor cloud, and it is advisable that personnel keep well outside the area of visible moisture.

Explosion Sensitivity to Mechanical Impact: Not Sensitive.

Explosion Sensitivity to Static Discharge: Static discharge may cause Ethylene to ignite explosively. The liquefied gas can accumulate static charge by flow, splashing or agitation.

SPECIAL FIRE-FIGHTING PROCEDURES: Structural fire-fighters must wear Self-Contained Breathing Apparatus and full protective equipment. The best fire-fighting technique may be simply to let the burning gas escape from the pressurized cylinder, tank car, or pipeline. Stop the leak before extinguishing fire. If the fire is extinguished before the leak is sealed, the still-leaking gas could explosively re-ignite without warning and cause extensive damage, injury, or fatality. In this case, increase ventilation (in enclosed areas) to prevent flammable mixture formation. For large releases, consider evacuation. Refer to the North American Emergency Response Guidebook for additional information.



**See Section 16 for
Definition of Ratings**

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a release, clear the affected area and protect people. Adequate fire protection must be provided. Minimum Personal Protective Equipment should be **Level B: fire-retardant protective clothing, mechanically-resistant gloves and Self-Contained Breathing Apparatus**. Use only non-sparking tools and equipment. Locate and seal the source of the leaking gas. Protect personnel attempting the shut-off with water-spray. Allow the gas to dissipate. Monitor the surrounding area for oxygen and combustible gas levels. Combustible gas concentration must be below 10% of the LEL (LEL = 2.7%) prior to entry of response personnel. The atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus. Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in-place or remove it to a safe area and allow the gas to be released there.

RESPONSE TO CRYOGENIC RELEASE: Clear the affected area and allow the liquid to evaporate and the gas to dissipate. After the gas is formed, follow the instructions provided in the previous paragraph. If the area must be entered by emergency personnel, SCBA, Kevlar gloves, and appropriate foot and leg protection must be worn.

THIS IS AN EXTREMELY FLAMMABLE GAS. Protection of all personnel and the area must be maintained.

PART III *How can I prevent hazardous situations from occurring?*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting Ethylene IN YOU. Do not eat or drink while handling chemicals. Be aware of any signs of dizziness or fatigue; due to oxygen deficiency, exposures to fatal concentrations of Ethylene could occur without any significant warning symptoms.

STORAGE AND HANDLING PRACTICES: Cylinders should be stored in dry, well-ventilated areas away from sources of heat. Compressed gases can present significant safety hazards. Store containers away from heavily trafficked areas and emergency exits. Post "No Smoking or Open Flames" signs in storage or use areas.

7. HANDLING and STORAGE (Continued)

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Protect cylinders against physical damage. Store in cool, dry, well-ventilated area, away from sources of heat, ignition and direct sunlight. Do not allow area where cylinders are stored to exceed 52°C (125°F). Isolate from oxidizers such as oxygen, chlorine, or fluorine. Use a check valve or trap in the discharge line to prevent hazardous backflow. Post "No Smoking or Open Flame" signs in storage and use areas. Cylinders should be stored upright and be firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Never tamper with pressure relief devices in valves and cylinders. Electrical equipment should be non-sparking or explosion proof. The following rules are applicable to work situations in which cylinders are being used:

Before Use: Move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap in-place (if provided) until cylinder is ready for use.

During Use: Use designated CGA fittings and other support equipment. Do not use adapters. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Use check valve or trap in discharge line to prevent hazardous backflow into the cylinder. Do not use oils or grease on gas-handling fittings or equipment.

After Use: Close main cylinder valve. Replace valve protection cap (if provided). Mark empty cylinders "EMPTY".

NOTE: Use only DOT or ASME code containers. Earth-ground and bond all lines and equipment associated with this gas. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of owner. For additional information refer to the Compressed Gas Association Pamphlet P-1, *Safe Handling of Compressed Gases in Containers*. Additionally, refer to CGA Bulletin SB-2 "Oxygen Deficient Atmospheres".

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (e.g., nitrogen) before attempting repairs.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to maintain oxygen levels above 19.5% in the workplace. Local exhaust ventilation is preferred, because it prevents Ethylene dispersion into the work place by eliminating it at its source. If appropriate, install automatic monitoring equipment to detect the level of oxygen and the presence of potentially flammable air-gas mixtures. Monitoring devices should be installed near the ceiling.

RESPIRATORY PROTECTION: Maintain oxygen levels above 19.5% in the workplace. If respiratory protection is needed, use only protection authorized in the U.S. Federal OSHA Standard (29 CFR 1910.134), applicable U.S. State regulations, or the Canadian CSA Standard Z94.4-93 and applicable standards of Canadian Provinces. Oxygen levels below 19.5% are considered IDLH by OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under OSHA's Respiratory Protection Standard (1910.134-1998).

EYE PROTECTION: Splash goggles, face-shield, or safety glasses, for protection from rapidly expanding gases and splashes of liquid Ethylene. If necessary, refer to U.S. OSHA 29 CFR 1910.133, or Canadian Standards.

HAND PROTECTION: Wear mechanically-resistant gloves when handling cylinders of this gas. Use low-temperature protective gloves (e.g., Kevlar) when working with containers of liquid Ethylene. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate for task. Transfer of large quantities under pressure may require protective equipment appropriate to protect employees from splashes of liquefied product, as well as fire retardant items. If a hazard of injury to the feet exists due to falling objects, rolling objects, where objects may pierce the soles of the feet or where employee's feet may be exposed to electrical hazards, use foot protection, as described in U.S. OSHA 29 CFR.

9. PHYSICAL and CHEMICAL PROPERTIES

VAPOR DENSITY: 1.261 kg/m³ (0.078 lb/ft³)

pH: Not applicable.

SPECIFIC GRAVITY (air = 1): 0.98

FREEZING POINT: -169°C (-272°F)

SOLUBILITY IN WATER: Soluble.

BOILING POINT: -104°C (-155 °F)

EVAPORATION RATE (nBuAc = 1): Not applicable.

EXPANSION RATIO: 489

ODOR THRESHOLD (detection): 270 ppm

VAPOR PRESSURE: Not applicable.

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

SPECIFIC VOLUME (ft³/lb): 13.8

APPEARANCE, ODOR AND COLOR: Colorless gas with a sweet odor. The cryogenic liquid is also colorless and has a sweet odor.

HOW TO DETECT THIS SUBSTANCE (warning properties): There are no distinct warning properties. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

10. STABILITY and REACTIVITY

STABILITY: Stable at standard temperatures and pressures. Explosive decomposition may occur in the absence of air at high temperatures (360°C) and pressures (17 MPa). Decomposition can occur at lower temperatures and pressures in the presence of high energy initiators (e.g. hot wire plus gun cotton, exploding wire, or electricity).

DECOMPOSITION PRODUCTS: When ignited in the presence of oxygen, this gas will decompose to produce carbon monoxide and carbon dioxide. Ethylene may oxidize to ethylene oxide in water.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Ethylene may react violently with the following materials: Strong oxidizers (e.g., chlorine, bromine pentafluoride, oxygen, oxygen difluoride, and nitrogen trifluoride); aluminum chloride, organic peroxides, copper, nitrogen dioxide, ozone, halocarbons, halogen acids, and hydrochloric acid.

HAZARDOUS POLYMERIZATION: May occur at elevated temperatures and in the presence of oxidizers.

CONDITIONS TO AVOID: Contact with incompatible materials and exposure to heat, sparks, static discharge and other sources of ignition and high pressures.

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: Dogs exposed to 1.4% Ethylene were anesthetized in 2-8.2 minutes. Decreased food intake, physical activity, white cell counts and platelet counts were observed in rats exposed to 60% (600,000 ppm) Ethylene in oxygen for 6 days. Additional information is as follows:

LC₅₀ (inhalation, mouse) = 96 pph

LCLo (inhalation, mammal) = 950,000 ppm/5 minutes

SUSPECTED CANCER AGENT: Ethylene is listed by agencies tracking the carcinogenic potential of chemical compounds, as follows:

ACGIH TLV-A4 (Not Classifiable as a Human Carcinogen); **IARC-3:** (Unclassifiable as Carcinogenicity in Humans); **MAK-3B:** (Substances for Which in vitro Tests or Animal Studies Have Yielded Evidence of Carcinogenic Effects That is Not Sufficient for Classification of the Substance in One of the Other Categories)

IRRITANCY OF PRODUCT: Ethylene is not irritating; however, contact with rapidly expanding gases can cause frostbite to exposed tissue.

SENSITIZATION TO THE PRODUCT: Ethylene is not known to cause skin or respiratory sensitization in humans.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Ethylene on the human reproductive system.

Mutagenicity: No mutagenicity effects have been described for Ethylene.

Teratogenicity: No teratogenicity effects have been described for Ethylene.

Embryotoxicity: No embryotoxic effects have been described for Ethylene.

Reproductive Toxicity: No reproductive toxicity effects have been described for Ethylene.

A *mutagen* is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An *embryotoxin* is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A *teratogen* is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A *reproductive toxin* is any substance which interferes in any way with the reproductive process.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) have not been determined for Ethylene.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: This gas will be dissipated rapidly in well-ventilated areas. The following are environmental data currently available for Ethylene.

Terrestrial Fate: Volatilization is expected to be the primary fate process of Ethylene in soil based on a measured vapor pressure of 5.213X10⁴ mm Hg at 25°C and a Henry's Law constant of 0.228 atm-cu m/mole at 25°C. Calculated Kocs of 100 and 300(3, SRC) indicate a medium to high mobility class for Ethylene in soils; however, its high vapor pressure would suggest that the gas may permeate through soil. Pure culture studies suggest that Ethylene may be susceptible to microbial degradation; however, it is expected to oxidize to ethylene oxide which is not metabolized and may accumulate in the environment.

Aquatic Fate: Ethylene may oxidize to ethylene oxide in water. Hydrolysis of Ethylene is not expected to be an important fate process in aquatic environments. Estimated Kocs of 100 and 300 and a high vapor pressure of 5.213X10⁴ mm Hg at 25°C indicate that the gas may permeate through organic matter contained in sediments and suspended material. The experimental Henry's Law constant of 0.228 atm-cu m/mole at 25°C suggests rapid volatilization of ethylene from environmental waters. Based on this Henry's Law constant, the volatilization half-life from a model river has been estimated to be 1.6 hours.]

Atmospheric Fate: Based on the experimental vapor pressure of 5.213X10⁴ mm Hg at 25°C, Ethylene is expected to exist almost entirely in the vapor phase in the ambient atmosphere. Vapor-phase Ethylene will degrade rapidly in the ambient atmosphere by reaction with photochemically produced hydroxyl radicals with a half-life of about 1.9 days. Vapor-phase Ethylene will also degrade in the ambient atmosphere by reaction with ozone and nitrate radicals with respective half-lives of 6.5 and 190 days.

Bioconcentration: No bioaccumulation. Based on a measured water solubility of 131 mg/L at 25°C, a measured log octanol/water partition coefficient of 1.13, and recommended regression-derived equations, BCFs for Ethylene can be estimated to be 40 and 4, respectively. These BCF values indicate that bioconcentration in aquatic organisms will not be an important fate process for Ethylene.

12. ECOLOGICAL INFORMATION (Continued)

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Any adverse effect on animals would be related to oxygen deficient environments. Ethylene in excess of 0.5 ppm in air may injure crops over a 24 hour exposure period. The following toxicity data are available for Ethylene's effects on plant-life.

<p>Vanda Orchid = 1 ppm/24 hours; fading of flowers. <i>Antirrhinum majus</i> = 0.1 ppm/1 hour; abscission of flowers. Orchid buds - 0.01 ppm/24 hours; 0.05/6 hours; 0.3 ppm/1 hour; sepal tissue collapse. <i>Chenopodium album</i> = 0.05 ppm; epinasty (bending of petals downward) <i>Dianthus caryophyllus</i> = 0.1/6 hours; inhibited flower opening. <i>Cossypium hirsutum</i> = 0.62/720 ppm; reduction in growth and yield. <i>Lilium regale</i>; 4.0 ppm; growth retardation and epinasty.</p>	<p><i>Rosa</i> species = 0.33 - 40.0 ppm/24-168 hours; growth retardation, epinasty, petal fall Tomato = 0.04-0.1 ppm/3-48 hours; leaf epinasty. African Marigold = 0.001 ppm/ leaf epinasty Lemon = 0.025-0.05; epinasty <i>Datura stramonium</i> = 0.1 ppm; close to limit for response <i>Lycopersium esulenyum</i> = 0.2 ppm; leaf epinasty <i>Begonia luminosa</i> = 8 ppm; slight epinasty Sweet pea = 0.1-0.4 ppm; production of triple response; horizontal mutation and swelling.</p>
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EFFECT OF CHEMICAL ON AQUATIC LIFE: The following aquatic toxicity data are available for Ethylene:

LD (sunfish) = 22 ppm /1 hour in freshwater

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Product removed from the cylinder must be disposed of in accordance with appropriate U.S. Federal, State, and local regulations or with regulations of Canada and its Provinces. Return cylinders with residual product to Airgas, Inc. Do not dispose of locally.

14. TRANSPORTATION INFORMATION

THIS GAS IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

	<u>Ethylene Gas:</u>	<u>Liquefied Ethylene:</u>
<u>PROPER SHIPPING NAME:</u>	Ethylene, compressed	Ethylene, refrigerated liquid
<u>HAZARD CLASS NUMBER and DESCRIPTION:</u>	2.1 (Flammable Gas)	2.1 (Flammable Gas)
<u>UN IDENTIFICATION NUMBER:</u>	UN 1962	UN 1038
<u>PACKING GROUP:</u>	Not Applicable	Not Applicable
<u>DOT LABEL(S) REQUIRED:</u>	Class 2.1 (Flammable Gas)	Class 2.1 (Flammable Gas)
<u>NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000):</u>	116P (Gas); 115 (Liquid)	
<u>MARINE POLLUTANT:</u>	Ethylene is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).	

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas is considered as Dangerous Goods, per regulations of Transport Canada. The use of the above U.S. DOT information from the U.S. 49 CFR regulations is allowed for shipments that originate in the U.S. For shipments via ground vehicle or rail that originate in Canada, the following information is applicable.

	<u>Ethylene Gas:</u>	<u>Liquefied Ethylene:</u>
<u>PROPER SHIPPING NAME:</u>	Ethylene, compressed	Ethylene, refrigerated liquid
<u>HAZARD CLASS NUMBER and DESCRIPTION:</u>	2.1 (Flammable Gas)	2.1 (Flammable Gas)
<u>UN IDENTIFICATION NUMBER:</u>	UN 1962	UN 1038
<u>PACKING GROUP:</u>	Not Applicable	Not Applicable
<u>HAZARD LABEL(S) REQUIRED:</u>	Class 2.1 (Flammable Gas)	Class 2.1 (Flammable Gas)
<u>SPECIAL PROVISIONS:</u>	None	None
<u>EXPLOSIVE LIMIT & LIMITED QUANTITY INDEX:</u>	0.12	0.12
<u>ERAP INDEX:</u>	3000	3000
<u>PASSENGER CARRYING SHIP INDEX:</u>	Forbidden	Forbidden
<u>PASSENGER CARRYING ROAD OR RAIL VEHICLE INDEX:</u>	Forbidden	Forbidden
<u>MARINE POLLUTANT:</u>	Ethylene is not a Marine Pollutant.	

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: Ethylene is subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows:

CHEMICAL NAME	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Ethylene	NO	NO	YES

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this material. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Ethylene is a CERCLA Hazardous Substance, but has not been assigned a specific CERCLA RQ.

15. REGULATORY INFORMATION (Continued)

ADDITIONAL U.S. REGULATIONS (continued):

U.S. TSCA INVENTORY STATUS: Ethylene is on the TSCA Inventory.

OTHER U.S. FEDERAL REGULATIONS: Ethylene may be subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for this gas is 10,000 lb (4540 kg). Depending on specific operations involving the use of Ethylene, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Under this regulation Ethylene is not listed in Appendix A, however, any process that involves a flammable gas on-site, in one location, in quantities of 10,000 lb (4,553 kg) or greater is covered under this regulation unless it is used as a fuel.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Ethylene is not on the California Proposition 65 lists.

CGA LABELING (For Compressed Gas):

DANGER: FLAMMABLE HIGH PRESSURE GAS.
CAN FORM EXPLOSIVE MIXTURES WITH AIR.
MAY CAUSE FROSTBITE.
Keep away from heat, flames, and sparks.
Avoid contact with skin and eyes.
Store and use with adequate ventilation.
Use equipment rated for cylinder pressure.
Close valve after each use and when empty.
Use in accordance with the Material Safety Data Sheet.

FIRST-AID: **IN CASE OF FROSTBITE,** obtain immediate medical attention.
DO NOT REMOVE THIS PRODUCT LABEL

ADDITIONAL CANADIAN REGULATIONS:

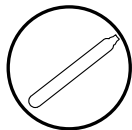
CANADIAN DSL/NDL INVENTORY STATUS: Ethylene is on the DSL Inventory.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: Ethylene is not on the CEPA Priorities Substances Lists.

CANADIAN WHMIS CLASSIFICATION AND SYMBOLS:

Class A: Compressed Gases

Class B1: Flammable Gas



16. OTHER INFORMATION

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
PO Box 3519, La Mesa, CA 91944-3519
619/670-0609

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. Airgas, Inc. assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, Airgas, Inc. assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number that uniquely identifies each constituent.

EXPOSURE LIMITS IN AIR:

CEILING LEVEL: The concentration that shall not be exceeded during any part of the working exposure.

LOQ: Limit of Quantitation.

MAK: Federal Republic of Germany Maximum Concentration Values in the workplace.

NE: Not Established. When no exposure guidelines are established, an entry of NE is made for reference.

NIC: Notice of Intended Change.

NIOSH CEILING: The exposure that shall not be exceeded during any part of the workday. If instantaneous monitoring is not feasible, the ceiling shall be assumed as a 15-minute TWA exposure (unless otherwise specified) that shall not be exceeded at any time during a workday.

NIOSH RELs: NIOSH's Recommended Exposure Limits.

EXPOSURE LIMITS IN AIR (continued):

PEL-Permissible Exposure Limit: OSHA's Permissible Exposure Limits. This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (*Federal Register*: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL that was vacated by Court Order.

SKIN: Used when there is a danger of cutaneous absorption.

STEL-Short Term Exposure Limit: Short Term Exposure Limit, usually a 15-minute time-weighted average (TWA) exposure that should not be exceeded at any time during a workday, even if the 8-hr TWA is within the TLV-TWA, PEL-TWA or REL-TWA.

TLV-Threshold Limit Value: An airborne concentration of a substance that represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour.

DEFINITIONS OF TERMS (Continued)

EXPOSURE LIMITS IN AIR (continued):

TWA-Time Weighted Average: Time Weighted Average exposure concentration for a conventional 8-hr (TLV, PEL) or up to a 10-hr (REL) workday and a 40-hr workweek.

IDLH-Immediately Dangerous to Life and Health: This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM

HAZARD RATINGS: This rating system was developed by the National Paint and Coating Association and has been adopted by industry to identify the degree of chemical hazards.

HEALTH HAZARD:

0 (Minimal Hazard): No significant health risk, irritation of skin or eyes not anticipated. *Skin Irritation:* Essentially non-irritating. PII or Draize = "0". *Eye Irritation:* Essentially non-irritating, or minimal effects which clear in < 24 hours [e.g. mechanical irritation]. Draize = "0". *Oral Toxicity LD₅₀ Rat:* < 5000 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit:* < 2000 mg/kg. *Inhalation Toxicity 4-hrs LC₅₀ Rat:* < 20 mg/L.; **1 (Slight Hazard):** Minor reversible Injury may occur; slightly or mildly irritating. *Skin Irritation:* Slightly or mildly irritating. *Eye Irritation:* Slightly or mildly irritating. *Oral Toxicity LD₅₀ Rat:* > 500-5000 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit:* > 1000-2000 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* > 2-20 mg/L.; **2 (Moderate Hazard):** Temporary or transitory injury may occur. *Skin Irritation:* Moderately irritating; primary irritant; sensitizer. PII or Draize > 0, < 5. *Eye Irritation:* Moderately to severely irritating and/or corrosive; reversible corneal opacity; corneal involvement or irritation clearing in 8-21 days. Draize > 0, ≤ 25. *Oral Toxicity LD₅₀ Rat:* > 50-500 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit:* > 200-1000 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* > 0.5-2 mg/L.; **3 (Serious Hazard):** Temporary or transitory injury may occur. *Skin Irritation:* Moderately irritating; primary irritant; sensitizer. PII or Draize > 0, < 5. *Eye Irritation:* Moderately to severely irritating and/or corrosive; reversible corneal opacity; corneal involvement or irritation clearing in 8-21 days. Draize > 0, ≤ 25. *Oral Toxicity LD₅₀ Rat:* > 50-500 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit:* > 200-1000 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* > 0.5-2 mg/L.; **4 (Severe Hazard):** Life-threatening; major or permanent damage may result from single or repeated exposure. *Skin Irritation:* Not appropriate. Do not rate as a "4", based on skin irritation alone. *Eye Irritation:* Not appropriate. Do not rate as a "4", based on eye irritation alone. *Oral Toxicity LD₅₀ Rat:* ≤ 1 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit:* ≤ 20 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* ≤ 0.05 mg/L).

FLAMMABILITY HAZARD:

0 (Minimal Hazard-Materials that will not burn in air when exposure to a temperature of 815.5°C [1500°F] for a period of 5 minutes.); **1 (Slight Hazard-Materials that must be pre-heated before ignition can occur.** Material require considerable pre-heating, under all ambient temperature conditions before ignition and combustion can occur, Including: Materials that will burn in air when exposed to a temperature of 815.5°C (1500°F) for a period of 5 minutes or less; Liquids, solids and semisolids having a flash point at or above 93.3°C [200°F] (e.g. OSHA Class IIIB, or; Most ordinary combustible materials [e.g. wood, paper, etc.]; **2 (Moderate Hazard-Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.** Materials in this degree would not, under normal conditions, form hazardous atmospheres in air, but under high ambient temperatures or moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres in air, Including: Liquids having a flash-point at or above 37.8°C [100°F] Solid materials in the form of course dusts that may burn rapidly but that generally do not form explosive atmospheres; Solid materials in a fibrous or shredded form that may burn rapidly and create flash fire hazards (e.g. cotton, sisal, hemp; Solids and semisolids that readily give off flammable vapors.);

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM

HAZARD RATINGS (continued):

FLAMMABILITY HAZARD (continued):

3 (Serious Hazard- Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures, or, unaffected by ambient temperature, are readily ignited under almost all conditions, including: Liquids having a flash point below 22.8°C [73°F] and having a boiling point at or above 38°C [100°F] and below 37.8°C [100°F] [e.g. OSHA Class IB and IC]; Materials that on account of their physical form or environmental conditions can form explosive mixtures with air and are readily dispersed in air [e.g., dusts of combustible solids, mists or droplets of flammable liquids]; Materials that burn extremely rapidly, usually by reason of self-contained oxygen [e.g. dry nitrocellulose and many organic peroxides]; **4 (Severe Hazard-Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air, and which will burn readily, including:** Flammable gases; Flammable cryogenic materials; Any liquid or gaseous material that is liquid while under pressure and has a flash point below 22.8°C [73°F] and a boiling point below 37.8°C [100°F] [e.g. OSHA Class IA; Material that ignite spontaneously when exposed to air at a temperature of 54.4°C [130°F] or below [e.g. pyrophoric].

PHYSICAL HAZARD:

0 (Water Reactivity): Materials that do not react with water. *Organic Peroxides:* Materials that are normally stable, even under fire conditions and will not react with water. *Explosives:* Substances that are Non-Explosive. *Unstable Compressed Gases:* No Rating. *Pyrophorics:* No Rating. *Oxidizers:* No "0" rating allowed. *Unstable Reactives:* Substances that will not polymerize, decompose, condense or self-react.; **1 (Water Reactivity):** Materials that change or decompose upon exposure to moisture. *Organic Peroxides:* Materials that are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but will not release energy. *Explosives:* Division 1.5 & 1.6 substances that are very insensitive explosives or that do not have a mass explosion hazard. *Compressed Gases:* Pressure below OSHA definition. *Pyrophorics:* No Rating. *Oxidizers:* Packaging Group III; *Solids:* any material that in either concentration tested, exhibits a mean burning time less than or equal to the mean burning time of a 3:7 potassium bromate/cellulose mixture and the criteria for Packing Group I and II are not met. *Liquids:* any material that exhibits a mean pressure rise time less than or equal to the pressure rise time of a 1:1 nitric acid (65%)/cellulose mixture and the criteria for Packing Group I and II are not met. *Unstable Reactives:* Substances that may decompose, condense or self-react, but only under conditions of high temperature and/or pressure and have little or no potential to cause significant heat generation or explosive hazard. Substances that readily undergo hazardous polymerization in the absence of inhibitors.; **2 (Water Reactivity):** Materials that may react violently with water. *Organic Peroxides:* Materials that, in themselves, are normally unstable and will readily undergo violent chemical change, but will not detonate. These materials may also react violently with water. *Explosives:* Division 1.4 – Explosive substances where the explosive effect are largely confined to the package and no projection of fragments of appreciable size or range are expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package. *Compressed Gases:* Pressurized and meet OSHA definition but < 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics:* No Rating. *Oxidizers:* Packaging Group II *Solids:* any material that, either in concentration tested, exhibits a mean burning time of less than or equal to the mean burning time of a 2:3 potassium bromate/cellulose mixture and the criteria for Packing Group I are not met. *Liquids:* any material that exhibits a mean pressure rise time less than or equal to the pressure rise of a 1:1 aqueous sodium chlorate solution (40%)/cellulose mixture and the criteria for Packing Group I are not met. *Unstable Reactives:* Substances that may polymerize, decompose, condense, or self-react at ambient temperature and/or pressure, but have a low potential for significant heat generation or explosion. Substances that readily form peroxides upon exposure to air or oxygen at room temperature);

DEFINITIONS OF TERMS (Continued)

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

PHYSICAL HAZARD (continued):

3 (Water Reactivity): Materials that may form explosive reactions with water. **Organic Peroxides:** Materials that are capable of detonation or explosive reaction, but require a strong initiating source, or must be heated under confinement before initiation; or materials that react explosively with water. **Explosives:** Division 1.2 – Explosive substances that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but do not have a mass explosion hazard. **Compressed Gases:** Pressure \geq 514.7 psi absolute at 21.1°C (70°F) [500 psig]. **Pyrophorics:** No Rating. **Oxidizers:** Packing Group I **Solids:** any material that, in either concentration tested, exhibits a mean burning time less than the mean burning time of a 3:2 potassium bromate/cellulose mixture. **Liquids:** Any material that spontaneously ignites when mixed with cellulose in a 1:1 ratio, or which exhibits a mean pressure rise time less than the pressure rise time of a 1:1 perchloric acid (50%/cellulose mixture). **Unstable Reactives:** Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a moderate potential to cause significant heat generation or explosion.); **4 (Water Reactivity):** Materials that react explosively with water without requiring heat or confinement. **Organic Peroxides:** Materials that are readily capable of detonation or explosive decomposition at normal temperature and pressures. **Explosives:** Division 1.1 & 1.2-explosive substances that have a mass explosion hazard or have a projection hazard. A mass explosion is one that affects almost the entire load instantaneously. **Compressed Gases:** No Rating. **Pyrophorics:** Add to the definition of Flammability "4". **Oxidizers:** No "4" rating. **Unstable Reactives:** Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a high potential to cause significant heat generation or explosion.).

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS:

HEALTH HAZARD: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure could cause death or major residual injury).

FLAMMABILITY HAZARD: **0** Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand. **1** Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur. **2** Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating could release vapor in sufficient quantities to produce hazardous atmospheres with air. **3** Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions. **4** Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and will burn readily.

INSTABILITY HAZARD: **0** Materials that in themselves are normally stable, even under fire conditions. **1** Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures. **2** Materials that readily undergo violent chemical change at elevated temperatures and pressures. **3** Materials that in themselves are capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation. **4** Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures.

FLAMMABILITY LIMITS IN AIR: Much of the information related to fire and explosion is derived from the National Fire Protection Association (NFPA). **Flash Point** - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. **Autoignition Temperature:** The minimum temperature required to initiate combustion in air with no other source of ignition. **LEL** - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. **UEL** - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Human and Animal Toxicology: Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD₅₀** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC₅₀** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m³** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **Cancer Information:** The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. **Other Information:** **BEI** - ACGIH Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.

ECOLOGICAL INFORMATION:

EC is the effect concentration in water. **BCF** = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter. **TL_m** = median threshold limit; Coefficient of Oil/Water Distribution is represented by **log K_{ow}** or **log K_{oc}** and is used to assess a substance's behavior in the environment.

REGULATORY INFORMATION:

U.S. and CANADA:

This section explains the impact of various laws and regulations on the material. **ACGIH:** American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **EPA** is the U.S. Environmental Protection Agency. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (**SARA**); the Canadian Domestic/Non-Domestic Substances List (**DSL/NDL**); the U.S. Toxic Substance Control Act (**TSCA**); Marine Pollutant status according to the **DOT**; the Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA** or **Superfund**); and various state regulations. This section also includes information on the precautionary warnings which appear on the material's package label. **OSHA** - U.S. Occupational Safety and Health Administration.